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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
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NASA-03131 (June 2004)  
NASA  
Superseding NASA-03131  
(December 2003)  
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SECTION 03131

PERMANENT STEEL FORMS  
06/04

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers short-span, corrugated-type, metal form decking to receive normal-weight concrete fill or lightweight concrete fill.

Drawings must include the following:

A complete design indicating the character of the work to be performed, giving the structural framing, metal form unit section properties, details of accessories, details of openings, and sufficient dimensions to convey adequately the quantity and nature of the required metal form decking

Assumed loads and other design data as may be required for the proper preparation of shop drawings

Metal decking for roof construction consisting of insulation board and built-up roofing placed over short-span, narrow-rib-type, steel roof decking is specified in Section 05312 STEEL ROOF DECK.

Metal decking for floor and roof constructions consisting of concrete fill placed over cellular-steel floor decking or combination of cellular and open-beam floor decking, with cells of cellular-steel floor decking suitable for use as electrical raceways or air ducts, if required, are specified in Section 05311 STEEL FLOOR DECK.

Portland cement, normal-aggregate concrete fill, including reinforcement, nonpermanent forms, and concrete placement, are specified in Section 03305 CAST-IN-PLACE CONCRETE (SHORT SECTION).

Lightweight, non-insulating concrete floor fill is specified in Section 03331 LIGHTWEIGHT ARCHITECTURAL CONCRETE.

Fire-resistance-rated floor or roof and ceiling constructions using corrugated-type metal form

decking are described in Underwriters Laboratories, Inc., "Fire Resistance Ratings (BXUV)" included in UL FRD and the "Fire Resistance Ratings" contained in AIA CO-1. Fire-resistance-rated construction limits the minimum metal gage thickness, pitch of the corrugations, and coverage of the metal form units; the method of fastening the metal form units to the supporting members; the type and spacing of the floor or roof framing; the materials and proportions for the concrete fill; and type of ceiling construction.

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## PART 1 GENERAL

### 1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

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The publications listed below form a part of this section to the extent referenced:

#### AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2004) Structural Welding Code - Steel

#### ASTM INTERNATIONAL (ASTM)

ASTM A 446/A 446M	(2003) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 780	(2001) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM D 1056

(2000) Standard Specification for Flexible  
Cellular Materials - Sponge or Expanded  
Rubber

## 1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions  
in Section 01330 SUBMITTAL PROCEDURES and edit the  
following list to reflect only the submittals  
required for the project. Submittals should be kept  
to the minimum required for adequate quality  
control. Include a columnar list of appropriate  
products and tests beneath each submittal  
description.

\*\*\*\*\*

The following shall be submitted in accordance with Section 01330 SUBMITTAL  
PROCEDURES in sufficient detail to show full compliance with the  
specification:

### SD-02 Shop Drawings

The following drawings shall be submitted by the Contractor in  
accordance with paragraph entitled, "Shop Drawings," of this  
section.

Fabrication Drawings  
Installation Drawings

### SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following  
items:

Steel Sheets  
Welding Electrodes  
Galvanizing Repair Coating  
Flexible Closure Strips  
Metal Form Units  
Metal Closure Strips

### SD-04 Samples

Contractor shall submit the following samples:

One of each type of fasteners to be used as required to illustrate  
the method of fastening the metal form units, and one of each type  
Flexible Closure Strips.

### SD-08 Manufacturer's Instructions

Installation instructions shall indicate the manufacturer's  
recommended method and sequence of installation for the following  
in accordance with paragraph entitled, "Installation," of this  
section.

Metal Form Units  
Accessories

## SD-07 Certificates

Welding Procedures shall be in accordance with AWS D1.1/D1.1M.

Certificates of compliance for Welder Qualifications shall be in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Certificates shall be provided for the following items showing conformance with the referenced standards contained in this section.

Galvanizing Repair Coating  
Flexible Closure Strips  
Steel Sheets  
Welding Electrodes

### 1.3 QUALIFICATIONS FOR WELDING WORK

\*\*\*\*\*  
NOTE: If Section 05095 WELDING STEEL CONSTRUCTION  
is not included in the project specification,  
applicable requirements therefrom should be inserted  
and the following paragraph deleted.  
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[Section 05095 WELDING STEEL CONSTRUCTION applies to work specified in this section.]

[Welding Procedures shall be in accordance with AWS D1.1/D1.1M.]

Welder qualifications shall have been verified by passing tests in accordance with AWS D1.1/D1.1M or equivalent qualification tests approved in advance. Welders shall be permitted to perform only the types of weld for which they are specifically qualified.]

### 1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of shop drawings and fabrication.

### 1.5 DELIVERY, STORAGE, AND HANDLING

Metal Form Units stored at the project site before erection shall be stacked on platforms or pallets and covered with suitable material to provide a weathertight enclosure while affording proper air circulation.

Packaged materials shall be stored in their original, unbroken package or container in a weathertight and dry place until ready for installation.

Decking shall not be used for storage or as a working platform until the metal form units have been permanently fastened in position. Decking shall not be damaged or overloaded.

### 1.6 PERFORMANCE REQUIREMENTS - PROPERTIES OF SECTIONS

Metal form unit section properties, including section modulus and moment of inertia per foot millimeter of width, shall equal or exceed the required

values of section properties indicated.

## 1.7 Shop Drawings

Fabrication Drawings shall show framing details, layout, and size and number of openings to be cut for structural deck systems.

Installation Drawings for structural deck systems shall indicate accessories and methods of installation, including reinforcement at openings; the location, lengths, and markings of the permanent Metal Form Units corresponding with the sequence and procedure to be followed in placing and fastening the metal form units; the location and type of fasteners; and the sequence of welded connections. Welds shall be indicated in accordance with AWS A2.4. Drawings shall also show metal form cross-section with dimensions and complete computations of metal form unit section properties as well as the location of all fire-resistance rated construction.

## PART 2 PRODUCTS

### 2.1 STRUCTURAL QUALITY STEEL SHEETS

Steel Sheets shall be hot-dip galvanized, carbon-steel sheets having minimum yield point of 50,000 pounds per square inch (psi) 345 Megapascal conforming to ASTM A 446/A 446M, Grade D, with G90 coating conforming to ASTM A 525 ASTM A 525M.

### 2.2 COMMERCIAL QUALITY STEEL SHEETS

Steel Sheets shall be hot-dip galvanized, carbon-steel sheets with G90 coating conforming to ASTM A 526/A 526M.

### 2.3 WELDING ELECTRODES FOR MANUAL SHIELDED METAL ARC WELDING

Electrodes shall conform to the requirements of AWS D1.1/D1.1M.

### 2.4 GALVANIZING REPAIR COATING

Coating shall be a high-zinc-dust content product for regalvanizing welds in galvanized steel and shall conform to ASTM A 780.

### 2.5 FLEXIBLE CLOSURE STRIPS

\*\*\*\*\*  
**NOTE: Delete paragraph heading and the following paragraphs when fire-resistance-rated construction is required.**  
\*\*\*\*\*

Closure strips shall be made of the elastomeric material specified and shall be premolded to the configuration required to provide tight-fitting closures at the open ends and sides of the permanent metal form decking.

Elastomeric material shall be a vulcanized, closed-cell, expanded chloroprene elastomer, having approximately 3.5 psi 24 kilopascal compression-deflection at 25-percent deflection (limits), conforming to ASTM D 1056, Grade No. SCE 41.

Adhesive shall be elastomeric type with a chloroprene base as recommended

by the manufacturer of the Flexible Closure Strips.

## 2.6 FABRICATION

### 2.6.1 Permanent Metal Form Units

Metal Form Units shall be corrugated and shall be fabricated of the specified structural quality steel sheets.

Metal form units shall be of sufficient length to span three or more spacings where possible.

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**NOTE: When fire-resistance-rated construction is required, the fire-rating agency's specifications for the applicable floor or roof construction must be checked.**

\*\*\*\*\*

Metal form units shall have the depth, pitch of corrugations, and nominal thickness of steel sheets as follows:

DEPTH MINIMUM <u>inches</u>	PITCH OF CORRUGATION MAXIMUM <u>inches</u>	THICKNESS OF STEEL SHEETS NOMINAL BEFORE GALVANIZING (MANUFACTURER'S STANDARD GAGE) <u>inches/gage</u>
9/16 inches	3 inches	0.0149 inch (28 gage)
7/8 inches	3-3/4 inches	0.0179 inch (26 gage)
1-5/16 inches	5-1/2 inches	0.0239 inch (24 gage)
1-5/16 inches	5-1/2 inches	0.0299 inch (22 gage)
1-5/16 inches	5-1/2 inches	0.0359 inch (20 gage)

DEPTH MINIMUM <u>millimeter</u>	PITCH OF CORRUGATION MAXIMUM <u>millimeter</u>	RANGE OF THICKNESS OF STEEL SHEET NOMINAL BEFORE GALVANIZING <u>millimeter</u>
14	75	0.38 - 0.48
22	95	0.45 - 0.55
33	140	0.61 - 0.70
33	140	0.76 - 0.85
33	140	0.91 - 1.00

### 2.6.2 Metal Closure Strips

Closure strips shall be fabricated of the specified commercial quality steel sheets not less than nominal 0.0478-inch thick (manufacturers' standard 18 gage) 1.2 millimeter before galvanizing. Closure strips shall be of the configuration required to provide tight-fitting closure at the open ends of the metal form decking.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Permanent Metal Form Units and Accessories shall be installed in accordance with the approved shop drawings and data.

### 3.2 WELDING PROCEDURES

Procedures for manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work shall conform to AWS D1.1/D1.1M.

### 3.3 PLACING METAL FORM UNITS

Supporting members shall be completely in place before the placing of permanent metal form units is started. Metal Form Units shall be placed on the supporting steel framework and adjusted to final position with ends bearing on supporting members and accurately aligned end to end. Before being permanently fastened, form units shall be placed with the edges up and with the corrugations perpendicular to the supporting members. Sheets shall be lapped 1/2 corrugation at the side laps and a minimum of 2 inches 50 millimeter at the end laps. Placing and aligning of the metal form units shall be done so as to maintain the required number of units indicated.

### 3.4 FASTENING METAL FORM UNITS

Metal Form Units shall be fastened to the steel supporting members at ends and at intermediate supports by plug welding through welding washers, by self-tapping screws, or by special clips supplied by the metal form unit manufacturer. Spacing of welds shall not exceed 12 inches 300 millimeter on center. Fastening sequence and procedure shall be coordinated with the placing of the metal form units.

### 3.5 HANGER SLOTS

\*\*\*\*\*  
**NOTE: Delete paragraph heading and the following paragraph when other construction will not be suspended from the metal form decking.**  
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Hanger slots shall be punched in the Metal Form Units to receive hangers for the support of ceiling construction, piping, air ducts, and other construction. Hanger slots shall be provided as follows:

For suspended ceiling construction, locate hanger slots not more than 24 inches 600 millimeter on center in both directions, not more than 9 inches 230 millimeter from walls at ends, and not more than 12 inches 300 millimeter from walls at sides.

Where piping, air ducts, and other construction shall be suspended from the metal form decking, locate hanger slots as above.

### 3.6 CUTTING AND FITTING

Cutting and fitting of Metal Form Units shall be required for the passage



of other work projecting through, or adjacent to, the metal form decking.

Additional metal reinforcement and closure pieces shall be provided as required for strength, continuity of the metal form decking, or the support of other work.

### 3.7 REINFORCEMENT AT OPENINGS

\*\*\*\*\*  
**NOTE: Openings larger than 12 inches 300 millimeter  
in any dimension must be framed with steel  
supporting members and provided as a part of the  
structural framing system.**  
\*\*\*\*\*

Metal form decking around openings 6 to 12 inches 150 to 300 millimeter in size shall be reinforced by means of a flat galvanized structural quality steel sheet placed over the opening and welded to the top surface of the metal form decking. Steel sheet shall be not less than nominal thickness of 0.0359 inch (manufacturer's 20 gage standard) 0.9 millimeter before galvanizing and at least 12-inches 300 millimeter wider and longer in size than the opening. Spacing of welds shall not exceed 12 inches 300 millimeter with not less than one weld at each corner.

Metal closures shall be provided to close open ends of the metal form decking at cast-in-place concrete beams and other construction. Metal closures shall be fastened in position in a manner to prevent leakage of the concrete mix.

### 3.8 FLEXIBLE CLOSURE STRIPS

\*\*\*\*\*  
**NOTE: Delete paragraph heading and the following  
paragraph when fire-resistance-rated construction is  
required.**  
\*\*\*\*\*

Closure strips shall be provided to close open, uncovered ends of the metal form decking. Flexible closure strips shall be installed with elastomeric-type adhesive in accordance with the adhesive manufacturer's written directions.

### 3.9 TOUCHUP PAINTING

After metal form decking installation, scarred areas on top and bottom surfaces of metal form decking and on surfaces of supporting steel members shall be wire brushed, cleaned, and touchup painted. Scarred areas shall include welds, weld scars, bruises, and rust spots. Galvanized surfaces shall be touched up using galvanizing repair paint; painted surfaces shall be touched up with the specified paint.

-- End of Section --